IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of: White

Serial No.: 10/640,089 Group No.: 1734

Filed: August 13, 2003 Examiner: James Sells

For: METHOD OF APPARATUS FOR ENSURING UNIFORM BUILD QUALITY DURING OBJECT CONSOLIDATION

APPELLANT'S CORRECTED APPEAL BRIEF

Mail Stop Appeal Brief
Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Notification of Non-Compliant Appeal Brief mailed June 22, 2007, Appellant hereby submits its corrected Appeal Brief.

I. Real Party in Interest

The real party and interest in this case is Solidica, Inc., by assignment.

II. Related Appeals and Interferences

There are no appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. Status of Claims

The present application was filed with 43 claims. Claims 1-43 are pending, rejected and under appeal. Claim 1 is the sole independent claim.

IV. Status of Amendments Filed Subsequent Final Rejection

No after-final amendments have been filed.

V. Summary of Claimed Subject Matter

Independent claim 1 is directed to an improved additive manufacturing process, comprising the steps of providing a computer-aided design (CAD) description of a part to be fabricated; providing a feedstock of material increments, each having a peripheral shape and a bonding surface; consolidating the increments at a bond zone associated with their respective bonding surfaces in accordance with the CAD description to produce the part without melting the increments in bulk; and performing the following steps, alone or in combination, to improve uniformity in fabrication: maintaining consistent energy delivery to the bond zone (Specification, page 9, line 20 to page 10, line 20); maintaining consistent stiffness and mechanical resistance to vibration in the bond zone (Specification, page 10, line 21 to page 13, line 27); and maintaining uniform thermal conditions in the bond zone.

VI. Grounds of Objection/Rejection To Be Reviewed On Appeal

A. The rejection of claims 1-4, 10-15, 22-31, 34-37, 39 and 43 under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,450,393 to Doumanidis et al.

B. The rejection of claims 5-9, 16-21, 32-33, 38 and 40-42 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,450,393 to Doumanidis et al.

VII. Argument

A. <u>Claims 1-4, 10-15, 22-31, 34-37, 39 and 43</u>

Claim 1 includes the limitation of performing the following steps, alone or in combination, to improve uniformity in and additive manufacturing process:

> *maintaining* consistent energy delivery to the bond zone;
> *maintaining* consistent stiffness and mechanical resistance to vibration in the bond zone; and
> *maintaining* uniform thermal conditions in the bond zone. (Emphasis added)

The claim stands rejected under 35 U.S.C. §102(e) over U.S. Patent No. 6,450,393 to Doumanidis et al. The Examiner concedes that Doumanidis does not teach maintaining consistent stiffness and mechanical resistance to vibration in the bond zone, but argues that the steps of

maintaining consistent energy delivery and uniform thermal conditions are met because "Doumanidis controls the process so that the temperature rise is maintained in a specific range (i.e., 35-50%) and senses the temperature of the materials." (Final OA, Response to Arguments, p. 5)

The Examiner is stretching the actual teachings of the reference. First, Doumanidis does not technically "control the process" so that the temperature rise is maintained in a specific range (i.e., 35-50%). The relevant section of Doumanidis reads as follows:

> "It should be noted that during the above process, melting of the material does not take place. The temperature rise of the material is a function of the process settings, and its maximum range is between 35% and 50% of the material melting temperature." ('393 Patent, 9:51-54)

This passage makes it clear that once the "process settings" are dialed in, no "control" takes place. Indeed, the "process settings" do not even include temperature. Rather, the "process settings" are limited to the three-dimensional geometry, the sheet thickness, weld spacing, welding and cutting conditions.

> "Referring to FIG. 4, once the software inputs have been provided (i.e., the three-dimensional geometry, the sheet thickness, weld spacing, welding and cutting process condition) and the two-dimensional contours have been determined by the slicing algorithm, the three-dimensional part is ready to be produced. ('393 Patent, 8:65-9:3)

Thus, energy (or temperature) cannot possibly be "maintained" according to Doumanidis. Something cannot be "maintained" if it is not considered in the first place. That the "temperature rise of the material is a *function* of the process settings" simply means that temperature rise is a *byproduct* arising due to the three-dimensional geometry, sheet thickness, weld spacing, welding and cutting process conditions entered prior to part build.

The Examiner's argument that the system of Doumanidis "senses the temperature of the materials" appears to be untrue; at least, Appellant can find no disclosure whatsoever in Doumanidis as to temperature sensing during build. While Doumanidis does discuss embedding sensors, these are not used to "monitor" energy or temperature in the band zone. The Examiner is invited, in the Examiner's Answer, to point out exactly where, in the Doumanidis reference, one can find "sensing the temperature of the materials."

In Appellant's claim language, the word *maintaining* has been italicized because it must not be overlooked. In order to *maintain* something some form of monitoring must be carried out; some form of feedback is required to prevent runaway and out-of-range situations. In the system of Doumanidis this is simply not done. In the system of Doumanidis, after an initial process input, energy and/or temperature could become excessive and out of control because there is nothing watching these parameters. Moreover, the Examiner implies that "temperature" and energy" are one-in-the-same, but they are not. These is not a 1:1 correspondence between energy input and temperature rise because some of the energy goes in to bonding, and temperature rise is also a function of feedstock size, substrate size, part shape and other parameters.

It is well-settled that anticipation may be established only when a single prior-art reference discloses, expressly or under principles of inherency, each and every element of a claimed invention. RCA Corp. v. Applied Digital Data Systems, 730 F.2d 1440, 1444, 221 USPQ 385, 388 (Fed. Cir. 1984). Moreover, anticipation requires the presence of all elements of a claimed invention as arranged in the claim, such that a disclosure "that 'almost' meets that standard does not 'anticipate'." Connell v. Sears, Roebuck Co., 722 F.2d 1542, 1548, 220 USPQ 193, 198 (Fed. Cir. 1983). Accordingly, anticipation has not been established with respect to this aspect of the claim.

B. Claims 5-9, 16-21, 32-33, 38 and 40-42

Claims 5-9, 16-21, 32-33, 38 and 40-42 stand rejected under 35 U.S.C. §103(a) over Doumanidis et al. Rather than cite substantive disclosure from the prior art in support of the rejection, the Examiner simply takes "official notice" that the various steps and features set forth by Appellant are "well known" or "conventional." However, this is not the standard for establishing obviousness. The conclusion that the claimed subject matter is *prima facie* obvious must be supported by evidence, as shown by some objective teaching in the prior art or by knowledge generally available to one of ordinary skill in the art that would have led that individual to combine the relevant teachings of the references to arrive at the claimed invention. See In re Fine, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988).

Rejections based on §103 must rest on a factual basis with these facts being interpreted without hindsight reconstruction of the invention from the prior art. The examiner may not, because of doubt

that the invention is patentable, resort to speculation, unfounded assumption or hindsight reconstruction to supply deficiencies in the factual basis for the rejection. "Broad conclusory statements regarding the teaching of multiple references, standing alone, are not 'evidence.'" In re Dembiczak, 175 F.3d 994, 999, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999). "Mere denials and conclusory statements, however, are not sufficient to establish a genuine issue of material fact." Dembiczak, 175 F.3d at 999-1000, 50 USPQ2d at 1617, citing McElmurry v. Arkansas Power & Light Co., 995 F.2d 1576, 1578, 27 USPQ2d 1129, 1131 (Fed. Cir. 1993).

Conclusion

In conclusion, for the arguments of record and the reasons set forth above, all pending claims of the subject application continue to be in condition for allowance and Appellant seeks the Board's concurrence at this time.

Respectfully submitted,

By:________________

Date: July 23, 2007

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APPENDIX A

CLAIMS ON APPEAL

1. An improved additive manufacturing process, comprising the steps of:

providing a computer-aided design (CAD) description of a part to be fabricated;

providing a feedstock of material increments, each having a peripheral shape and a bonding surface;

consolidating the increments at a bond zone associated with their respective bonding surfaces in accordance with the CAD description to produce the part without melting the increments in bulk; and

performing the following steps, alone or in combination, to improve uniformity in fabrication:

maintaining consistent energy delivery to the bond zone;

maintaining consistent stiffness and mechanical resistance to vibration in the bond zone; and

maintaining uniform thermal conditions in the bond zone.

2. The method of claim 1, wherein the step of maintaining consistent energy delivery to the bond zone includes the steps of:

determining the local geometry of the part being fabricated; and

using the local geometry to apply appropriate weld parameters.

3. The method of claim 2, including the step of specifying the local geometry in terms of current bond zone width, height of feature, or location with respect to initiation or termination of the bond zone.

4. The method of claim 3, wherein the appropriate weld parameters calculated in real time in accordance with the local geometry.

5. The method of claim 3, further including the use of a look-up table containing previously identified weld parameters.

6. The method of claim 3, further including the use of an adaptive control method to derive the level of energy required for a uniform weld at the bond zone.

7. The method of claim 6, wherein the adaptive control method is based upon a Kalman filter or pole placement.

8. The method of claim 6, wherein the adaptive control method is based upon artificial intelligence.

9. The method of claim 8, wherein the artificial intelligence technique is based on a rule-based system, fuzzy logic, neural network, or genetic algorithm.

10. Te method of claim 1, wherein the step of maintaining consistent stiffness and mechanical resistance to vibration in the bond zone includes controlling applied force, the amplitude of the delivered energy, or welding speed.

11. The method of claim 1, wherein the step of maintaining consistent stiffness and mechanical resistance to vibration in the bond zone includes the use of initiation and termination process parameters during bonding.

12. The method of claim 11, wherein the initiation and termination process parameters are a function of the energy applied to the feature being built, the instantaneous aspect ratio of the part as it is built, the width of the feature, or the ratio of a feature dimension to feed dimension.

13. The method of claim 11, wherein the initiation and termination process parameters include force, speed, and/or ultrasonic wave amplitude.

14. The method of claim 11, wherein the initiation and termination process parameters are

used to compensate for variations in the solid mechanics of the component as its geometry changes.

15. The method of claim 11, wherein the initiation and termination process parameters are used to initiate the moving flowing plastic flow front at the interface between previously deposited material and the volume of material currently being applied.

16. The method of claim 1, further including the steps of:

using a grid or other geometric map to identify the aspect ratio and/or volume of discrete features on the object;

finding height-to-width ratio and/or total volume based upon the aspect ratio and/or volume of the discrete features; and

assigning appropriate processing parameters as a function of height-to-width ratio and/or total volume.

17. The method of claim 16, wherein the processing parameters include speed, pressure and/or amplitude.

18. The method of claim 16, wherein the step of finding height-to-width ratio and/or total volume uses a look-up table.

19. The method of claim 16, further including the step of determining whether or not to incorporate a support or stiffening feature through the use of the grid or other geometric map.

20. The method of claim 1, further including the step of varying feedstock geometry to increase the degree of relative motion in the X-Z or Y-Z plane.

21. The method of claim 20, further including the step of using geometries which include an angle in the relevant directions.

22. The method of claim 1, wherein the step of maintaining consistent stiffness and mechanical resistance to vibration in the bond zone includes the use of a support feature which is conducive to easy removal during trimming and finishing of the part.

23. The method of claim 22, wherein the support feature is a stepped buttress.

24. The method of claim 22, wherein the support feature is continuous, intermittent, applied around corners, applied only at corners, on the periphery of an entire part, at the periphery of a specific feature on a larger part, or along an edge.

25. The method of claim 1, wherein the step of maintaining uniform thermal conditions in the bond zone includes controlling the temperature of the build/part being produced, the substrate, the feedstock or the fabrication environment.

26. The method of claim 25, wherein the bond zone is heated to a temperature near the temperature of the feedstock.

27. The method of claim 25, wherein the bond zone is heated to a temperature between 0.2 and 0.8 of the melting temperature of the feedstock material.

28. The method of claim 25, further including the step of controlling the local thermal history in the bond zone using process parameter control, supplementary thermal control, or a combination thereof.

29. The method of claim 25, wherein the temperature of the entire build is controlled to within a desired temperature range.

30. The method of claim 29, including the use of a heat source secured to a build platform.

31. The method of claim 30, wherein the heat source is an electric base heater, IR heater, induction heater, radiative heater, strip heater, resistance heater, heat blanket, lasers, torch, or electronic heater.

32. The method of claim 30, wherein the heat source includes the use of air, hot water, hot oil, or steam.

33. The method of claim 30, wherein the heat is supplied through channels built into the object being fabricated.

34. The method of claim 30, wherein the heat source is controlled by a closed-loop process-parameter control system.

35. The method of claim 30, wherein the closed-loop process-parameter control system uses contacting or non-contacting temperature sensors.

36. The method of claim 30, including the use of local as opposed to general heating of the part.

37. The method of claim 36, wherein the local heating is provided by a laser, or other high intensity light source.

38. The method of claim 37, wherein the local heating source travels in conjunction with an ultrasonic sonotrode.

39. The method of claim 22, including the step of generating a consistent thermal profile by heating of the feedstock, a sonotrode or both.

40. The method of claim 22, including the use of an open- or closed-loop technique for

ensuring that the temperature remains within a set range.

41. The method of claim 40, wherein the technique includes a sensor driven control system based upon adaptive feedback or artificial intelligence.

42. The method of claim 40, wherein the technique includes the use of an expert system, fuzzy logic or neural network.

43. The method of claim 1, wherein the step of maintaining consistent stiffness and mechanical resistance to vibration in the bond zone includes the use of secondary materials.

APPENDIX B

EVIDENCE

None.

APPENDIX C

RELATED PROCEEDINGS

None.